

ISEN 220: Introduction to Energy Systems for the 21st Century

Winter 2014

MWF 1.00 – 1.50 pm, Annenberg G15

Textbook

“Sustainable Energy without the Hot Air”, David MacKay, downloadable free of charge from:

www.withouthotair.com/

Course Description

This survey course provides an overview of energy issues in the context of global sustainability. Energy demands for transportation, residential, and commercial uses are presented, and strategies for demand reduction are discussed. Major potential sustainable energy sources will be presented, including solar, wind, hydroelectric, geothermal, biofuels, waves and tides, along with coal, nuclear, and hydraulic fracturing technologies. Issues associated with carbon capture, energy storage, and the power grid will be discussed. While this course will address many technical and scientific aspects of energy, no prerequisite technical courses are required.

Approximate Syllabus

Week 1 – 3: Introduction, energy units, energy consumption and production, basic scientific principles, environmental effects, energy demand in different sectors

Week 4 – 6: Renewables and sustainables

Week 7 – 9: Reducing demand, energy storage and smart grid

Evaluation

Homework – 25% total; 2 exams – 50% total; group poster presentation and report – 25% total (A: 84% and greater; B: between 73% and 84). Both exams are open-book: you are permitted to use lecture notes, textbook, calculator, all written and printed materials.

Late homework: We post the solution on BlackBoard 24 hours after the homework is due. If the homework is submitted late but before the solution is posted, we will deduct 10% of the maximum score from that homework. We do not accept homework after the solution is posted.

Missed exam: No make-up exam is available, except under emergency or extraordinary circumstances.

Missed poster session: No make-up poster session is available.

Late term paper: No late term paper will be accepted.

Instructor Team

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Teaching assistants and grader:

Paul Edward Hartzog. Email: PaulHartzog2014@u.northwestern.edu

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Guest Lectures

Lightweight Alloys for Transportation – Prof. David Dunand, Materials Science and Engineering, Northwestern University, Feb 7

Biofuels – Prof. Harold Kung, Chemical Engineering, Northwestern University, Feb 12

Photovoltaics – Prof. Angus Rockett, University of Illinois, Feb 21

ISEN 220 Winter 2014 Approximate Calendar

Sunday	Monday	Tuesday	Wed	Thurs	Friday	Saturday
	Jan 6 Why sustainable? Reading: 1, 2	7	8 Why sustainable? Reading: 1, 2	9	10 No class	11
12	13 Scientific principles	14	15 Impact on environment	16	17 Energy demand: transportation Reading: 3, 5, A, C	18
19	20 Martin Luther King Day No class HW1 due 5 p.m.	21	22 Energy demand: heating, cooling, & lighting Reading: 7, 9	23	24 Energy demand: food, gadgets, & stuff Reading: 11, 13, 15, H	25
26	27 Renewables: photothermal Reading: 6	28	29 Renewables: photovoltaics	30	31 Renewables: winds, waves and tides Reading: 4,10,12,14,B,F,G	1
2	Feb 3 Renewables: hydroelectric, geothermal Reading: 8, 16 HW2 due 5 p.m.	4	5 EXAM1	6	7 Guest lecture: Lightweight alloys (Prof. D. Dunand)	8
9	10 Sustainables from conventional sources: coal; carbon capture Reading: 23, 31	11	12 Guest lecture: Biofuels (Prof. H. Kung) Reading: 6, D	13	14 Sustainable from conventional sources: nuclear Reading: 24	15
16	17 Reducing demand: efficient transportation Reading: 20, A, C Poster topic due HW3 due 5 p.m.	18	19 Reducing demand: efficient lighting	20	21 Guest lecture: Photovoltaics (Prof. A. Rockett)	22
23	24 Reducing demand: efficient heating and cooling Reading: 21, E	25	26 Student debate	27	28 Energy storage and the smart grid I Reading: 26	1
2	Mar 3 Energy storage and the smart grid II HW4 due 5 p.m.	4	5 EXAM2	6	7 Poster presentation I	8
9	10 Poster presentation II	11	12	13	14 Term paper due 5 p.m.	15

ISEN 220 Group Poster Presentation and Report Protocol

- Assemble a team of 3-4 members among your classmates
- Any reasonable energy topic is acceptable. Examples:
 - You have the attention of (President Shapiro, the Mayor of Evanston, President Obama, etc) for 15 minutes. What will you advise them about energy?
 - Top ten things to do, or not to do, about energy
 - Why is (solar, wind, geothermal, nuclear, etc.) the salvation for human civilization, or not?
 - New technologies on the horizon (solar, wind, lithium-ion batteries, etc)
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- Whatever the topic, it should be fun for you and your audience.
- Your team will be scheduled by lottery to do the poster presentation on one of two possible days: March 7 or 10. The venue will be Cook Hall first floor lobby. All team members must present the poster.
- **Important.** By 5 pm February 14 (preferably earlier), please send me an email about the poster presentation containing three key pieces of information (title, short description, and names of team members). Do not begin working on the poster until you receive explicit approval from me by return email.
- A short (6- to 8-page) term paper based on the poster must be emailed to me by 5 pm of March 14. Your report must cite all references.

Amber's Top Ten Rules for Good Homework (edited)

1. Write neatly on good-quality paper. If I can't read it, I can't grade it.
2. Show all the work in an organized way. If I can't follow your steps, I can't give partial credit.
3. Rules 1 and 2 might mean you have to recopy your work before turning it in. So be it.
4. Staple all homework pages together before submitting your homework.
5. All numerical answers must have units.
6. Remember your significant figures.
7. Leave plenty of space for each problem.
8. On the other hand, don't use more paper than necessary. Save a tree!
9. Brevity is the soul of wit. Keep written answers short and to the point.
10. After finishing a problem, stop and think. Is your answer reasonable within your current understanding of the universe?